# 1982

# AIR MONITORING REPORT

# EDMONTON METROPOLITAN AREA

1982

# AIR MONITORING REPORT
# EDMONTON METROPOLITAN AREA

prepared by

AIR QUALITY CONTROL BRANCH

POLLUTION CONTROL DIVISION

ENVIRONMENTAL PROTECTION SERVICES

ALBERTA ENVIRONMENT

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## SYNOPSIS

This report is an assessment of the ambient air quality in the Edmonton metropolitan area for the 1982 report year. The assessment is based on the results of the monitoring of various air pollutants by the Air Quality Control Branch of the Pollution Control Divison of Alberta Environment from January 1, 1982 to December 31, 1982.

The emphasis is on comparing the data with the levels outlined in the Alberta Clean Air (Maximum Levels) Regulations and on assessing the data for trends.

The meteorological data and the air quality indices--numerical indicators of air quality--which are based on readings of sulphur dioxide, ozone, carbon monoxide, suspended particulate matter, and nitrogen dioxide, are discussed in this report. Generally, the air quality was in the 'good' index range.

Considering data from 1974 to 1982, no apparent significant trends were found for carbon monoxide at any of the three monitoring stations, nor did soiling index exhibit any significant trend at the industrial area monitoring station. Upward trends were found for soiling index at both the downtown area monitoring station and the residential area monitoring station. Upward trends were also found for ozone at the industrial area monitoring station and for nitrogen dioxide at the residential area and the industrial area monitoring stations. Downward trends were found for nitrogen dioxide at the downtown area monitoring station, and for ozone at the residential area and the downtown area monitoring stations.

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# I. INTRODUCTION

The Air Quality Control Branch of Alberta Environment operates an on-going program of ambient air monitoring in the Edmonton metropolitan area. The objectives of this program are twofold: to provide data for the assessment of existing air quality; and to establish long-term trends in air quality. To achieve these goals, the Branch operates a comprehensive network of stations equipped to measure oxides of nitrogen, ozone, carbon monoxide, sulphur dioxide, total hydrocarbons, particulates and total sulphation.

The report summarizes the results of the monitoring of these air pollutants from January 1, 1982 to December 31, 1982.

The data obtained during this report year are compared with the air quality Regulations, which stipulate the maximum permissible concentrations of contaminants in the ambient air. The "maximum permissible concentrations" are listed in the Alberta Clean Air (Maximum Levels) Regulations.

The "Source and Emission Inventories" for the pollutants are also cited to provide information on the contribution of each major source (e.g. industry and motor vehicles) to the total emissions of each pollutant.

## II. THE AIR MONITORING NETWORK

The network of air monitoring stations in the Edmonton metropolitan area is comprised of two units: the continuous ambient air monitoring network, which collects data on oxides of nitrogen, ozone, carbon monoxide, sulphur dioxide and total hydrocarbons; and the static and intermittent air monitoring network, which samples total sulphation and particulates - soiling index, suspended particulate matter (high volume sampler) and total dustfall.

Figure 1 illustrates the locations of the three continuous air monitoring stations. The stations are designated EDMU, ERMU and EIMU. The designations refer to the general locations of the stations in the downtown, residential and industrial areas respectively. Table 1 lists the parameters that each station is equipped to monitor continuously and gives additional information about the stations.

The locations of the static and intermittent air monitoring stations are also shown in Figure 1. This network of stations is comprised of 24 exposure sites for measuring total sulphation and total dustfall and three sites for measuring soiling index and suspended particulate matter.

# FIGURE 1

N
N.A.R.
97 St.
City Boundary
137 Ave.
C.N.R.
ERMU
Fort Rd.
118 Ave.
C.N.R.
111 Ave.
97 St.
109 St.
101 St.
107 Ave.
102 Ave.
Jasper
EDMU
98 Ave.
EIMU
149 St
75 St.
White Ave.
82 Ave.
C.P.R.
114 St.
109 St.
104 St.
99 St.
Mill Rd.
Argyll
63 Ave.
61 Ave.
C.N.R.
City Boundary
RIVER
Creek
45 Ave.
Whitemud
C.P.R.
Creek
City Boundary
SASKATCHEWAN
NORTH
Calgary Trail
City Boundary
EDMONTON
LEGEND
Soiling Index
Hi - Volume
Exposure Cylinders
Continuous Monitors
Alberta
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TABLE 1

THE CONTINUOUS AMBIENT AIR MONITORING NETWORK

Parameters that Stations are Equipped to Monitor Continuously

| Station | Wind | $NO_x$ | $NO_2$ | $O_3$ | CO | $SO_2$ | THC |
|---|---|---|---|---|---|---|---|
| EDMU | - | X | X | X | X | - | X |
| EIMU | X | X | X | X | X | X | X |
| ERMU | X | X | X | X | X | - | X |

Note: EDMU - Edmonton Downtown Monitoring Unit
EIMU - Edmonton Industrial Monitoring Unit
ERMU - Edmonton Residential Monitoring Unit

$NO_x$ - Oxides of Nitrogen
$NO_2$ - Nitrogen Dioxide
$O_3$ - Ozone
CO - Carbon Monoxide
$SO_2$ - Sulphur Dioxide
THC - Total Hydrocarbons

Station Documentation

| Station | Station Address | Height of Station | Height of Sample Inlet Above Ground |
|---|---|---|---|
| EDMU | 104 St. and 103 Ave. | 5.5 m | 8.5 m |
| EIMU | 17 St. and 105 Ave. | 2.5 m | 5.0 m |
| ERMU | 127 St. and 133 Ave. | 2.5 m | 3.5 m |

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## III. THE AIR MONITORING INSTRUMENTATION

The detection principles and sampling periods of the pollutants monitored during the 1982 report year are presented in Table 2. Also included are the methods used to calibrate the instruments and the type of monitoring that was employed for each pollutant.

There are three basic types of ambient air monitoring, and they differ on the basis of the duration of the sampling periods: continuous, static and intermittent. Continuous monitoring is the sampling of the air on a continuous basis; static monitoring involves time periods of approximately 30 days; and intermittent monitoring encompasses 1-hour, 2-hour and 24-hour sampling time periods.

Monitoring of ambient air may also be categorized according to the method used for analyzing the sample, automatic or manual. Automatic analysis is accomplished by a system which has the capability of collecting the sample, analyzing it and giving a data read-out. This is exemplified by the monitoring of oxides of nitrogen, ozone, carbon monoxide, sulphur dioxide and total hydrocarbons. Manual analysis involves the collection of a sample and subsequent analysis at a laboratory. The monitoring of particulates and total sulphation are examples of the manual method.

TABLE 2

THE AIR MONITORING INSTRUMENTATION

| Pollutant | Detection Principle | Sampling Period | Type of Monitoring | Instrument Calibration Method |
|---|---|---|---|---|
| Nitrogen Dioxide | Chemiluminescence | Instantaneous (sample integration) | Continuous | Gas phase titration or Certified gas cylinder |
| Ozone | Chemiluminescence or Ultraviolet photometry | Instantaneous (sample integration) | Continuous | Gas phase titration |
| Carbon Monoxide | Nondispersive infrared radiation | Instantaneous (sample integration) | Continuous | Certified gas cylinder |
| Sulphur Dioxide | Coulometric detection or Pulsed fluorescence | Instantaneous (sample integration) | Continuous | Permeation tube |
| Total Hydrocarbons | Flame ionization | Instantaneous (sample integration) | Continuous | Certified gas cylinder |
| Suspended Particulate Matter (Soiling Index) | Tape sampler (light transmittance) | 1-hour or 2-hour | Intermittent | Rotameter - flow |
| Suspended Particulate Matter (High-Volume Sampler) | Gravimetry | 24-hour | Intermittent | Orifice plates |
| Total Sulphation | Chemical reaction | 30 days | Static | N/A |
| Total Dustfall | Gravimetry | 30 days | Static | N/A |



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## IV. AIR POLLUTANT DATA ANALYSES

### A. INTRODUCTION

In this section of the report, the pollutants are examined on an individual basis. The presentation includes general information on the pollutants, an overview of the prime emission sources as determined by the 1982 Source and Emission Inventory and an analysis of the data.

For the purposes of this report, the data are summarized. The summaries include arithmetic mean concentrations and the frequency of occurrence of concentrations in compliance with the Clean Air (Maximum Levels) Regulations.

Sufficient data must be available to constitute valid calculated mean values. When the instrument operational time is less than 50%, no arithmetic mean is calculated; and when the instrument is operational between 50% and 75% of the time, the arithmetic mean may not be representative of that period. Therefore, any comparisons of the data should take this into account.

Tables 3 and 4 are included to provide an overall picture of existing air quality and to give some idea of the trends of the air pollution levels over the past five years. A detailed look at trends is given in section IV. B.

TABLE 3

POLLUTANTS COMPARED WITH REGULATIONS(1)

1982

| POLLUTANT | PERCENT COMPLIANCE WITH REGULATIONS(1) | | | AIR QUALITY REGULATIONS |
|---|---|---|---|---|
| | EDMU | EIMU | ERMU | |
| Nitrogen Dioxide | | | | |
| 1-hour | 99.98 | 100 | 100 | 0.21 ppm |
| 24-hour | 99.71 | 100 | 100 | 0.11 ppm |
| Ozone | | | | |
| 1-hour | 99.95 | 99.83 | 99.89 | 0.080 ppm |
| 24-hour | 86.78 | 55.22 | 61.58 | 0.025 ppm |
| Carbon Monoxide | | | | |
| 1-hour | 99.84 | 100 | 99.82 | 13.0 ppm |
| 8-hour | 98.73 | 99.89 | 99.15 | 5.0 ppm |
| Sulphur Dioxide | | | | |
| 1-hour | - | 100 | - | 0.17 ppm |
| 24-hour | - | 100 | - | 0.06 ppm |
| Suspended Particulate Matter (Soiling Index-COH) | 100 | 100 | 100 | A minimum of 90% of readings per month shall be less than 1.0 COH. |
| Suspended Particulate Matter (High-Volume Sampler) | 66.67 | 77.57 | 88.14 | 100µg/m³/24hr |
| Total Dustfall(2) | | | | |
| Residential and Recreational Area Stations | | 71.84 | | 53 mg/100 cm²/30 days |
| Commercial and Industrial Area Stations | | 81.13 | | 158 mg/100 cm²/30 days |

(1) Clean Air (Maximum Levels) Regulations.
(2) No allowance made for normal background levels as required by (1).

TABLE 4

ANNUAL CONCENTRATION MEANS IN EDMONTON*
(1978-1982)

| | | 1978 | 1979 | 1980 | 1981 | 1982 |
|---|---|---|---|---|---|---|
| Nitrogen Dioxide (ppm) | EDMU | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| | EIMU | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| | ERMU | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 |
| Ozone (ppm) | EDMU | 0.009 | 0.012 | 0.012 | 0.012 | 0.014 |
| | EIMU | 0.017 | 0.023 | 0.019 | 0.021 | 0.024 |
| | ERMU | 0.017 | 0.019 | 0.015 | 0.018 | 0.021 |
| Carbon Monoxide (ppm) | EDMU | 2.2 | 3.3 | 2.8 | 2.2 | 1.9 |
| | EIMU | 0.4 | 0.4 | 0.8 | 1.0 | 0.9 |
| | ERMU | 1.3 | 1.9 | 1.9 | 1.6 | 1.0 |
| Total Hydrocarbons (ppm) | EDMU | 2.2 | 1.8 | 2.1 | 2.2 | 2.3 |
| | EIMU | 3.6 | 2.5 | 2.5 | 2.8 | 2.5 |
| | ERMU | 2.4 | 2.6 | 2.5 | 2.5 | 2.3 |
| Total Sulphation 24 Stations ($SO_3$ equiv. mg/100cm$^2$/day) | | 0.11 | 0.10 | 0.16 | 0.15 | 0.11 |
| Suspended Particulate Matter Soiling Index (COH Units) | EDMU | 0.20 | 0.27 | 0.32 | 0.37 | 0.30 |
| | EIMU | 0.14 | 0.21 | 0.23 | 0.22 | 0.09 |
| | ERMU | 0.17 | 0.25 | 0.29 | 0.29 | 0.25 |
| Suspended Particulate Matter High-Volume Sampler $\mu g/m^3$ (Geometric Mean) | EDMU | 83 | 102 | 104 | 103 | 75 |
| | EIMU | 66 | 77 | 72 | 66 | 59 |
| | ERMU | 66 | 92 | 81 | 64 | 50 |
| Total Dustfall | | | | | | |
| Residential and Recreational Area Stations (15) mg/100 cm$^2$/30 days | | 49 | 51 | 65 | 68 | 49 |
| Commercial and Industrial Area Stations (9) mg/100 cm$^2$/30 days | | 102 | 140 | 125 | 142 | 98 |

*For years 1978-1980 inclusive, means are based on climatic year (March of one year to February of the next year); from 1981 onwards, means are based on the calendar year.

B. TRENDS

Measurement uncertainties inherent in equipment, coupled with the variability of meteorological factors, the spatial variations of concentrations over a given area, and changes in the environment in proximity to the points of measurement, individually and collectively tend to obscure pollutant trends.

Preliminary analysis of each of the station histories indicated the data base was not entirely free of such problems. Whenever they occurrred, such problem areas were deleted from the data base, pending further study.

For the preliminary work, the analytical approach chosen was to employ yearly means of nitrogen dioxide, ozone, carbon monoxide, and suspended particulate matter (coefficient of haze). The year to year variability of the data was reduced by using moving means given by:

$$\overline{Yi} = \frac{\text{summation of } Yj \text{ from } j = i - k \text{ to } i + k}{m}$$

$$\& \; k = \frac{m - 1}{2}$$

where $\overline{Yi}$ is the smoothed value

Yj is the original value

m is the length of the smoothing interval'.

Three-year moving means were chosen (m=3), in part due to the number of available data points. Such a technique has been used in other air quality trend studies.[2] Summarized results are shown in Tables 5, 6, and 7 for EDMU, ERMU and EIMU respectively.

TABLE 5

YEARLY MEAN AND THREE-YEAR MOVING MEAN
POLLUTANT CONCENTRATIONS, 1974-1982

EDMONTON
EDMU

| YEAR | NITROGEN DIOXIDE | | OZONE | | CARBON MONOXIDE | | COEFFICIENT OF HAZE (COH) | |
|---|---|---|---|---|---|---|---|---|
| | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN |
| | (ppm) | | (ppm) | | (ppm) | | (COH) | |
| 1974 | - | - | .0150 | - | 1.93 | - | .047 | - |
| 1975 | .0520 | - | .0250 | .0213 | 1.54 | 1.68 | .133 | .123 |
| 1976 | .0525 | .0479 | .0240 | .0210 | 1.57 | 1.71 | .189 | .173 |
| 1977 | .0392 | .0445 | .0140 | .0158 | 2.01 | 1.88 | .198 | .195 |
| 1978 | .0417 | .0412 | .0093 | .0117 | 2.05 | 2.45 | .198 | .222 |
| 1979 | .0427 | .0401 | .0118 | .0110 | 3.28 | 2.77 | .269 | .255 |
| 1980 | .0358 | .0403 | .0118 | .0119 | 2.97 | 2.81 | .297 | .312 |
| 1981 | .0425 | .0383 | .0122 | .0127 | 2.18 | 2.35 | .370 | .323 |
| 1982 | .0367 | - | .0140 | - | 1.89 | - | .302 | - |

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TABLE 6

YEARLY MEAN AND THREE-YEAR MOVING MEAN
POLLUTANT CONCENTRATIONS, 1974-1982

EDMONTON
ERMU

| YEAR | NITROGEN DIOXIDE | | OZONE | | CARBON MONOXIDE | | COEFFICIENT OF HAZE (COH) | |
|---|---|---|---|---|---|---|---|---|
| | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN |
| | (ppm) | | (ppm) | | (ppm) | | (COH) | |
| 1974 | - | - | .0183 | - | 1.48 | - | .110 | - |
| 1975 | .0290 | - | .0258 | .0238 | 1.90 | 1.75 | .108 | .109 |
| 1976 | .0242 | .0244 | .0272 | .0227 | 1.86 | 1.75 | .110 | .112 |
| 1977 | .0200 | .0242 | .0150 | .0197 | 1.50 | 1.57 | .117 | .126 |
| 1978 | .0283 | .0258 | .0168 | .0170 | 1.34 | 1.53 | .150 | .166 |
| 1979 | .0292 | .0269 | .0192 | .0171 | 1.75 | 1.62 | .232 | .220 |
| 1980 | .0233 | .0278 | .0154 | .0175 | 1.78 | 1.72 | .279 | .265 |
| 1981 | .0310 | .0270 | .0178 | .0181 | 1.62 | 1.48 | .285 | .271 |
| 1982 | .0267 | - | .0210 | - | 1.04 | - | .248 | - |

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TABLE 7

YEARLY MEAN AND THREE-YEAR MOVING MEAN
POLLUTANT CONCENTRATIONS, 1974-1982

EDMONTON
EIMU

| | NITROGEN DIOXIDE | | OZONE | | CARBON MONOXIDE | | COEFFICIENT OF HAZE (COH) | |
|---|---|---|---|---|---|---|---|---|
| YEAR | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN | ARITHMETIC MEAN | 3-YEAR MOVING MEAN |
| | (ppm) | | (ppm) | | (ppm) | | (COH) | |
| 1974 | - | - | .0100 | - | 0.99 | - | .156 | - |
| 1975 | .0100 | - | .0167 | .0164 | 1.27 | 0.97 | .094 | .098 |
| 1976 | .0092 | .0117 | .0224 | .0180 | 0.64 | 0.76 | .043 | .076 |
| 1977 | .0158 | .0147 | .0148 | .0179 | 0.36 | 0.44 | .090 | .088 |
| 1978 | .0192 | .0192 | .0165 | .0180 | 0.33 | 0.36 | .132 | .141 |
| 1979 | .0225 | .0195 | .0228 | .0197 | 0.39 | 0.46 | .201 | .187 |
| 1980 | .0167 | .0203 | .0199 | .0212 | 0.66 | 0.69 | .227 | .216 |
| 1981 | .0217 | .0184 | .0208 | .0215 | 1.01 | 0.86 | .220 | .178 |
| 1982 | .0167 | - | .0239 | - | 0.91 | - | .088 | - |

In addition, plots of the three-year moving means were made (Figures 2, 3, 4, 5) for $NO_2$, $O_3$, CO, and COH. Trend lines for the three-year moving means were determined for each of the pollutants and COH, an example of which is shown in Figure 6 (for $NO_2$ at EDMU).

Each of the trend lines were tested to see whether or not there was any significant trend over the period 1974 to 1982. The results of this analysis are shown in Table 8.

Considering data from 1974 to 1982, no apparent significant trends were found for carbon monoxide at any of the three monitoring stations, nor did soiling index (coefficient of haze) exhibit any significant trend at EIMU. Downward trends for ozone were found at EDMU and ERMU (upward at EIMU), and a downward trend for nitrogen dioxide was found at EDMU (upward at ERMU and EIMU). Upward trends were found for soiling index (coefficient of haze) at both ERMU and EDMU.

Careful interpretation is required when examining the apparent trends, which are sensitive to the number of data points. Changes on a yearly basis are small, but all indicated slopes are significantly different from zero. However, it would be highly unlikely that any pollutant would continue a downward trend to zero concentration. Thus, these trends represent only the short-term conditions of 1974-1982 and are therefore mere snapshots in time of a larger, more complex situation.

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FIGURE 2
THREE-YEAR MOVING MEAN OF YEARLY AVERAGE
NITROGEN DIOXIDE CONCENTRATIONS AT EDMONTON
FOR THE PERIOD 1974 – 1982

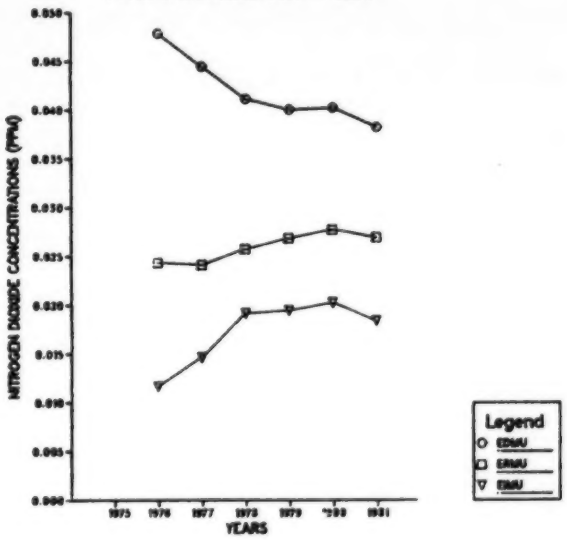


FIGURE 3
THREE-YEAR MOVING MEAN OF YEARLY AVERAGE
OZONE CONCENTRATIONS AT EDMONTON
FOR THE PERIOD 1974 – 1982

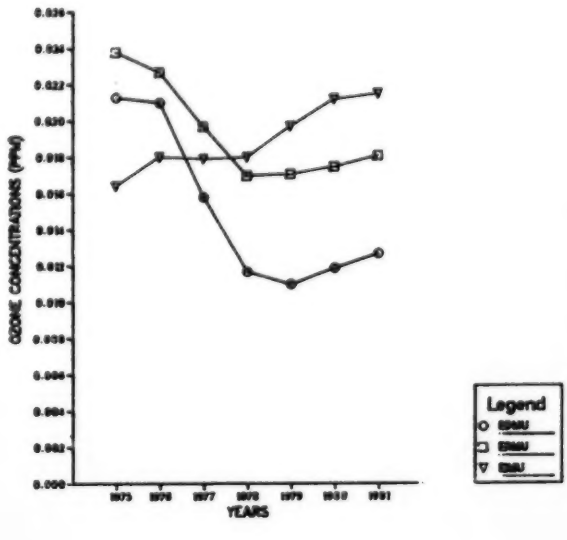

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FIGURE 4
THREE-YEAR MOVING MEAN OF YEARLY AVERAGE
CARBON MONOXIDE CONCENTRATIONS AT EDMONTON
FOR THE PERIOD 1974 – 1982

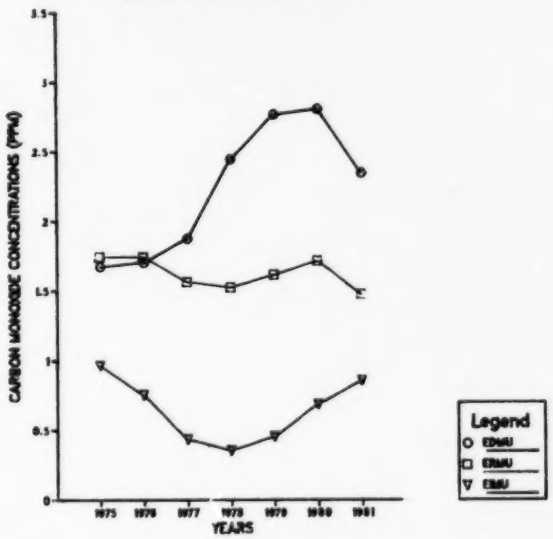
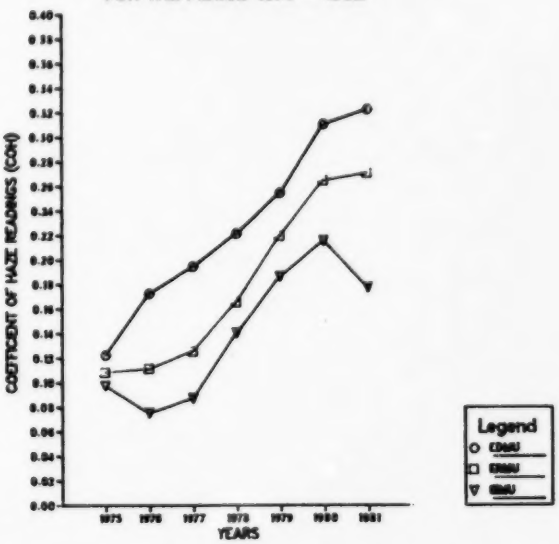



FIGURE 5
THREE-YEAR MOVING MEAN OF YEARLY AVERAGE
COEFFICIENT OF HAZE READINGS AT EDMONTON
FOR THE PERIOD 1974 – 1982



# FIGURE 6
# THREE–YEAR MOVING MEAN OF YEARLY AVERAGE NITROGEN DIOXIDE CONCENTRATIONS AT EDMU FOR THE PERIOD 1974 – 1982

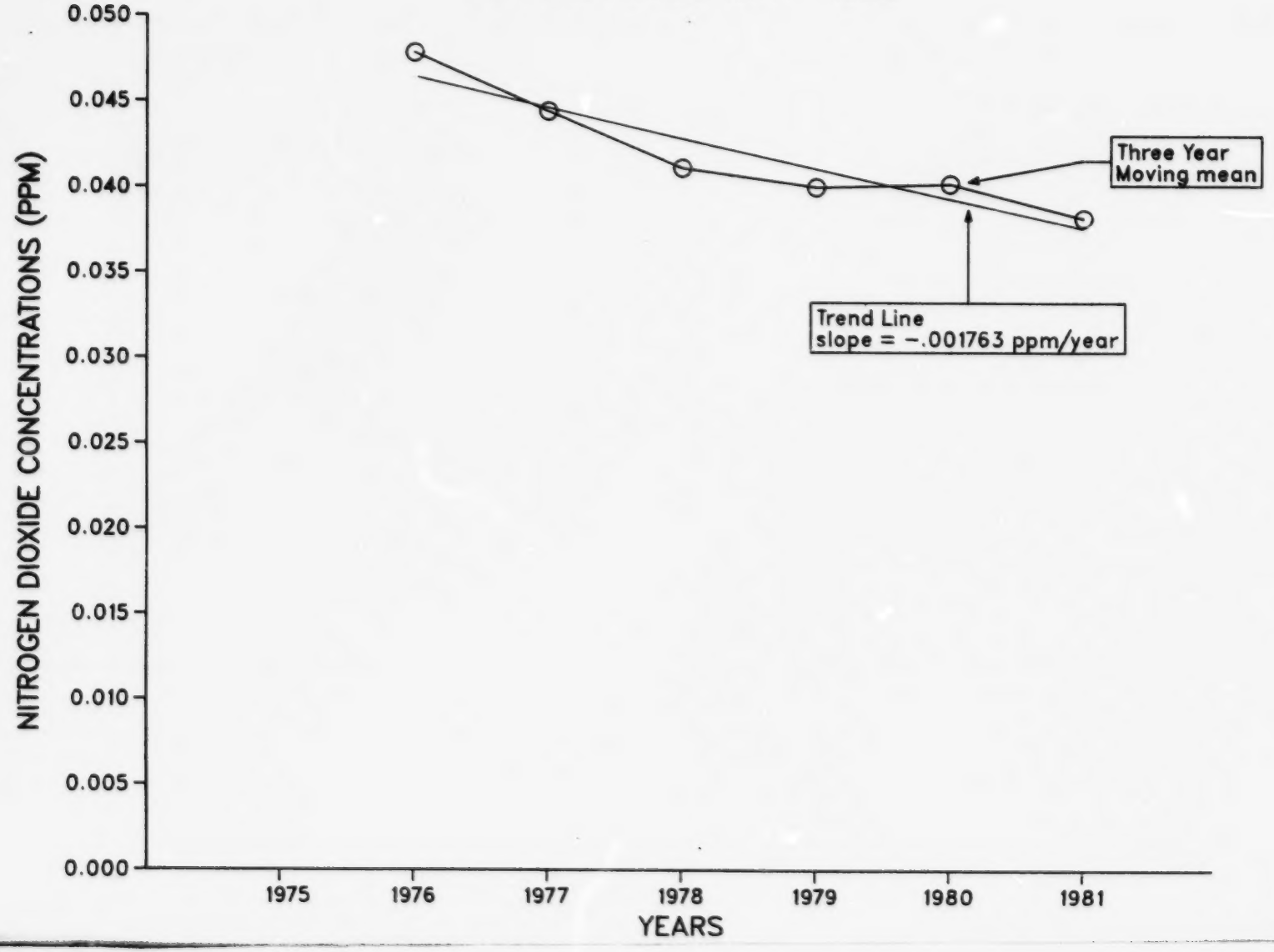





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TABLE 8
SUMMARY OF THREE-YEAR MOVING MEAN
TRENDS FOR POLLUTANTS AND COH
DURING THE PERIOD 1974-1982

EDMONTON

| | EDMU | | ERMU | | EIMU | |
|---|---|---|---|---|---|---|
| POLLUTANT | TREND CHARACTERISTICS | RATE OF CHANGE | TREND CHARACTERISTICS | RATE OF CHANGE | TREND CHARACTERISTICS | RATE OF CHANGE |
| Nitrogen Dioxide | downward | -0.001763 ppm/yr | upward | 0.000711 ppm/yr | upward | 0.001446 ppm/yr |
| Ozone | downward | -0.001743 ppm/yr | downward | -0.001075 ppm/yr | upward | 0.000839 ppm/yr |
| Carbon Monoxide | no apparent significant trend | - | no apparent significant trend | - | no apparent significant trend | - |
| Coefficient of Haze | upward | 0.0335 (COH units)/yr | upward | 0.0316 (COH units)/yr | no apparent significant trend | - |

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C. OXIDES OF NITROGEN ($NO_x$)

Oxides of nitrogen are composed of two major constituents: nitrogen dioxide ($NO_2$) and the less toxic nitric oxide (NO). Both pollutants originate from natural and man-made processes. Nitrogen and oxygen, the principle constituents of the atmosphere, combine during high temperature combustion to form $NO_x$.[3] The major man-made source is from the burning of fossil fuels such as natural gas, coal, oil and gasoline.

In the Edmonton metropolitan area, motor vehicles contribute about half of the oxides of nitrogen emissions, (49.7%), while major industrial sources contribute 34.7% (Figure 7 - "Source and Emission Inventory").

The major oxide of nitrogen at the point of combustion is nitric oxide. A small fraction of the nitric oxide is converted to nitrogen dioxide by photochemical oxidation. Since it has been demonstrated that nitrogen dioxide can cause deleterious effects, and is the more toxic oxide of nitrogen, the emphasis here will be placed on nitrogen dioxide.

Nitrogen dioxide is an orange-brown gas with a characteristic pungent odour. Because of its colouration, it has been postulated that $NO_2$ is responsible for a portion of the brownish discolouration of air masses near urban areas.

The results of the monitoring of $NO_2$ during the 1982 report period are presented in Table 9 and Figure 7. All the monitored levels were 100% in compliance with the Regulations, with the exception of 99.7% compliance and 96.0 % compliance in February with the 1-hour and 24-hour Regulations respectively at EDMU. Vehicular traffic exhaust is responsible for the small amount of non-compliance time.

TABLE 9
NITROGEN DIOXIDE/OXIDES OF NITROGEN

Alberta ENVIRONMENT
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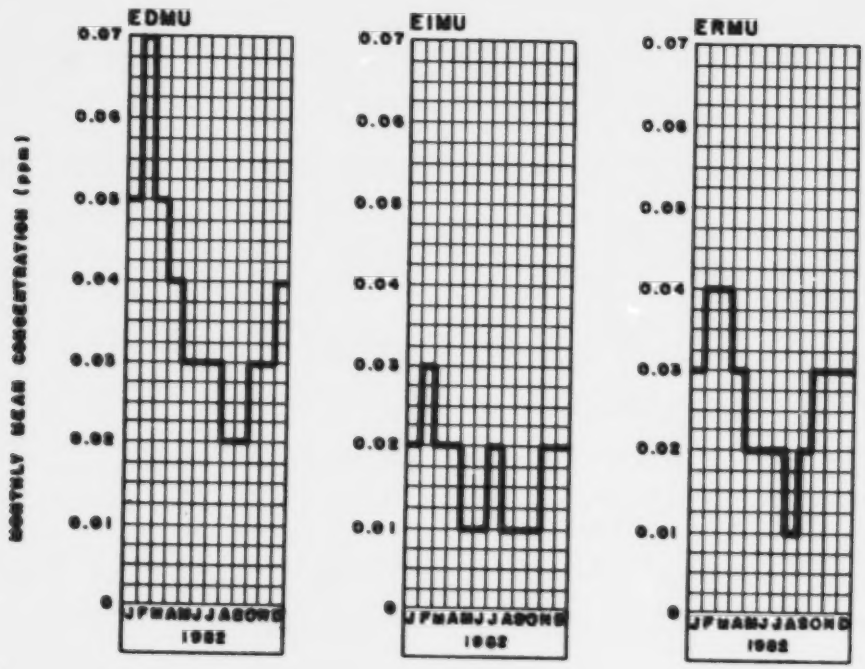
MAXIMUM LEVELS REGULATIONS
1-HOUR-0.21 PPM 24-HOUR-0.11 PPM

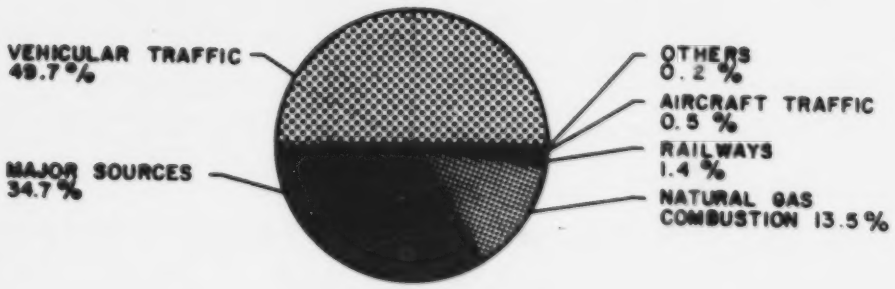
| MONTH | ARITHMETIC MEAN (ppm) | | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | | PERCENT COMPLIANCE WITH $NO_2$ REGULATIONS | |
|---|---|---|---|---|---|---|
| | $NO_2$ | $NO_x$ | $NO_2$ | $NO_x$ | 1-HR | 24-HR |
| **EDMU** | | | | | | |
| January, 1982 | 0.05 | 0.14 | 97.4 | 97.4 | 100 | 100 |
| February | 0.07 | 0.17 | 90.3 | 90.3 | 99.7 | 96.0 |
| March | 0.05 | 0.08 | 97.7 | 97.7 | 100 | 100 |
| April | 0.04 | 0.06 | 97.5 | 97.5 | 100 | 100 |
| May | 0.03 | 0.04 | 97.4 | 97.4 | 100 | 100 |
| June | 0.03 | 0.04 | 94.9 | 94.9 | 100 | 100 |
| July | 0.03 | 0.05 | 97.4 | 97.4 | 100 | 100 |
| August | 0.02 | 0.05 | 97.2 | 97.2 | 100 | 100 |
| September | 0.02 | 0.06 | 96.1 | 96.1 | 100 | 100 |
| October | 0.03 | 0.09 | 97.2 | 97.2 | 100 | 100 |
| November | 0.03 | 0.11 | 97.5 | 97.5 | 100 | 100 |
| December | 0.04 | 0.13 | 78.5 | 91.5 | 100 | 100 |
| **EIMU** | | | | | | |
| January, 1982 | 0.02 | 0.05 | 95.7 | 95.7 | 100 | 100 |
| February | 0.03 | 0.06 | 96.4 | 96.4 | 100 | 100 |
| March | 0.02 | 0.04 | 84.4 | 88.3 | 100 | 100 |
| April | 0.02 | 0.03 | 96.0 | 96.0 | 100 | 100 |
| May | 0.01 | 0.02 | 97.0 | 97.0 | 100 | 100 |
| June | 0.01 | 0.03 | 96.4 | 96.4 | 100 | 100 |
| July | 0.02 | 0.03 | 96.6 | 96.8 | 100 | 100 |
| August | 0.01 | 0.03 | 96.5 | 96.6 | 100 | 100 |
| September | 0.01 | 0.03 | 96.7 | 96.7 | 100 | 100 |
| October | 0.01 | 0.04 | 97.2 | 97.2 | 100 | 100 |
| November | 0.02 | 0.05 | 76.0 | 76.0 | 100 | 100 |
| December | 0.02 | 0.06 | 91.3 | 91.3 | 100 | 100 |
| **ERMU** | | | | | | |
| January, 1982 | 0.03 | 0.09 | 89.0 | 93.8 | 100 | 100 |
| February | 0.04 | 0.10 | 96.9 | 96.9 | 100 | 100 |
| March | 0.04 | 0.07 | 96.6 | 96.6 | 100 | 100 |
| April | 0.03 | 0.06 | 94.4 | 94.4 | 100 | 100 |
| May | 0.02 | 0.03 | 97.0 | 97.0 | 100 | 100 |
| June | 0.02 | 0.03 | 97.2 | 97.2 | 100 | 100 |
| July | 0.02 | 0.03 | 97.0 | 97.2 | 100 | 100 |
| August | 0.01 | 0.03 | 97.4 | 97.4 | 100 | 100 |
| September | 0.02 | 0.04 | 96.4 | 96.4 | 100 | 100 |
| October | 0.03 | 0.09 | 95.3 | 95.6 | 100 | 100 |
| November | 0.03 | 0.09 | 96.4 | 96.4 | 100 | 100 |
| December | 0.03 | 0.11 | 96.4 | 96.4 | 100 | 100 |

# FIGURE 7 - OXIDES OF NITROGEN

## $NO_2$ MONTHLY MEANS




## SOURCE AND EMISSION INVENTORY




RELATIVE CONTRIBUTION OF EACH CATEGORY TO TOTAL OXIDES OF NITROGEN EMISSIONS IN THE EDMONTON AREA, 1982

OXIDES OF NITROGEN
19947 tonnes

Alberta
ENVIRONMENT
Pollution Control Division

D. OZONE ($O_3$)

Unlike many other pollutants, ozone is not introduced directly to the air by man's activities. In the upper atmosphere, ozone is a naturally occurring constituent; in the lower atmosphere or ambient air, ozone is the primary end-product of photochemical oxidation involving the nitrogen oxides, ultraviolet light energy and reactive hydrocarbons. Ozone plays an important role in the absorption of harmful ultraviolet radiation in the upper atmosphere; however, in ambient air it can be harmful to humans, vegetation and various materials.

Table 10 and Figure 8 present a summary of the ozone data collected for this report year. Several observations can be made: there was a frequent occurrence of readings in excess of the Clean Air (Maximum Levels) Regulations for a 24-hour period; ERMU and EIMU recorded higher levels than EDMU; and the ozone levels were highest during the spring and summer months at all three stations.

The high frequency of readings in excess of the 24-hour Regulation is attributable to the high natural levels of ozone in Alberta, constituting what is referred to as "background" levels. The background levels can fluctuate depending on environmental conditions and can exceed the 24-hour Regulation.[4]

The higher concentrations of ozone recorded at ERMU and EIMU, relative to EDMU, may not be indicative of local sources but may have resulted from wind transportation of the precursors to those areas. The elevated readings in spring and summer are indicative of the increase in ultraviolet light energy, which enhances the photochemical production of ozone.

TABLE 10
OZONE

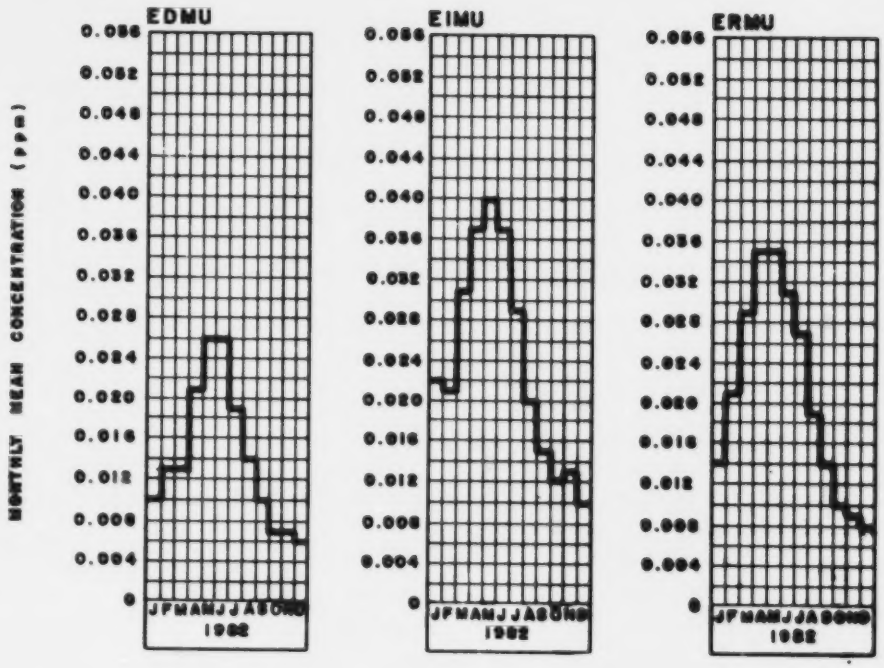
Alberta ENVIRONMENT Pollution Control Division Air Quality Control Branch

MAXIMUM LEVELS REGULATIONS
1-HOUR-0.080 PPM 24-HOUR-0.025 PPM

| MONTH | ARITHMETIC MEAN (ppm) | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | PERCENT COMPLIANCE WITH REGULATIONS | |
|---|---|---|---|---|
| | | | 1-HR | 24-HR |
| **EDMU** | | | | |
| January, 1982 | 0.010 | 93.1 | 100 | 96.5 |
| February | 0.013 | 94.6 | 100 | 92.5 |
| March | 0.013 | 96.1 | 100 | 100 |
| April | 0.021 | 96.1 | 100 | 79.2 |
| May | 0.026 | 95.8 | 100 | 42.8 |
| June | 0.026 | 93.6 | 99.4 | 50.1 |
| July | 0.019 | 95.8 | 100 | 83.2 |
| August | 0.014 | 95.8 | 100 | 96.6 |
| September | 0.010 | 95.3 | 100 | 100 |
| October | 0.007 | 95.8 | 100 | 100 |
| November | 0.007 | 95.8 | 100 | 100 |
| December | 0.006 | 95.8 | 100 | 100 |
| **EIMU** | | | | |
| January, 1982 | 0.022 | 95.6 | 100 | 56.1 |
| February | 0.021 | 95.4 | 100 | 66.3 |
| March | 0.031 | 89.7 | 100 | 28.0 |
| April | 0.037 | 95.4 | 100 | 2.2 |
| May | 0.040 | 95.8 | 100 | 0.0 |
| June | 0.037 | 92.9 | 98.5 | 6.7 |
| July | 0.029 | 95.8 | 99.4 | 29.3 |
| August | 0.020 | 95.7 | 100 | 83.1 |
| September | 0.015 | 95.7 | 100 | 100 |
| October | 0.012 | 95.7 | 100 | 100 |
| November | 0.013 | 95.6 | 100 | 96.5 |
| December | 0.010 | 94.8 | 100 | 93.2 |
| **ERMU** | | | | |
| January, 1982 | 0.014 | 96.1 | 100 | 89.9 |
| February | 0.021 | 95.8 | 100 | 70.2 |
| March | 0.029 | 95.8 | 100 | 25.9 |
| April | 0.035 | 95.0 | 100 | 8.8 |
| May | 0.035 | 95.8 | 100 | 5.8 |
| June | 0.031 | 94.4 | 98.7 | 25.9 |
| July | 0.027 | 95.8 | 100 | 32.7 |
| August | 0.019 | 95.8 | 100 | 86.5 |
| September | 0.014 | 95.7 | 100 | 100 |
| October | 0.010 | 96.0 | 100 | 100 |
| November | 0.009 | 95.3 | 100 | 100 |
| December | 0.008 | 95.2 | 100 | 93.2 |

# FIGURE 8 - OZONE

## MONTHLY MEANS




## SOURCE AND EMISSION INVENTORY

SINCE OZONE IS A NATURALLY OCCURRING AIR CONTAMINANT, AND IS ALSO A PRODUCT OF PHOTOCHEMICAL REACTION, THE SOURCE AND EMISSION INVENTORY IS NOT APPLICABLE.

E. CARBON MONOXIDE (CO)

Carbon monoxide is an odourless, colourless gas. It is emitted into the atmosphere in greater quantities than any other urban air pollutant. The majority of the carbon monoxide found in urban air comes from man-made sources. Natural sources, such as forest fires and plant decay, maintain a very low background level.

The 1982 "Source and Emission Inventory" for the Edmonton metropolitan area (Figure 9) indicates that vehicular traffic is the major source of CO, (96.4%). Much smaller contributions are made by such sources as fireplaces (1.0%), major industrial sources (1.0%), aircraft traffic (0.8%), natural gas combustion (0.5%), and others (0.3%).

There were averages of 99.9% compliance and 99.3% compliance respectively with the 1-hour and the 8-hour carbon monoxide Regulations, averaged for all three monitoring stations for the report year. Vehicular traffic exhaust is responsible for the small amount of non-compliance time.

The generally higher carbon monoxide levels monitored at EDMU relative to ERMU and EIMU, (Table 11 and Figure 9) are indicative of the vehicular traffic density in the downtown area. Diurnal variations of CO levels indicate that peak levels occur during or immediately following peak rush hour periods. The data also indicate that the lowest CO concentrations were monitored during the spring and summer seasons at all three stations. This seasonal variation of CO levels results from changes in meteorolcgical

parameters. In the fall and winter, the colder ambient temperatures result in emissions of CO, from motor vehicles, particularly during vehicle startups. In addition, the more stable atmospheric conditions and low wind speeds which occur during the fall and winter result in decreased dispersion of CO emissions and consequently higher ground level CO concentrations, relative to spring and summer concentrations.

TABLE 11
CARBON MONOXIDE

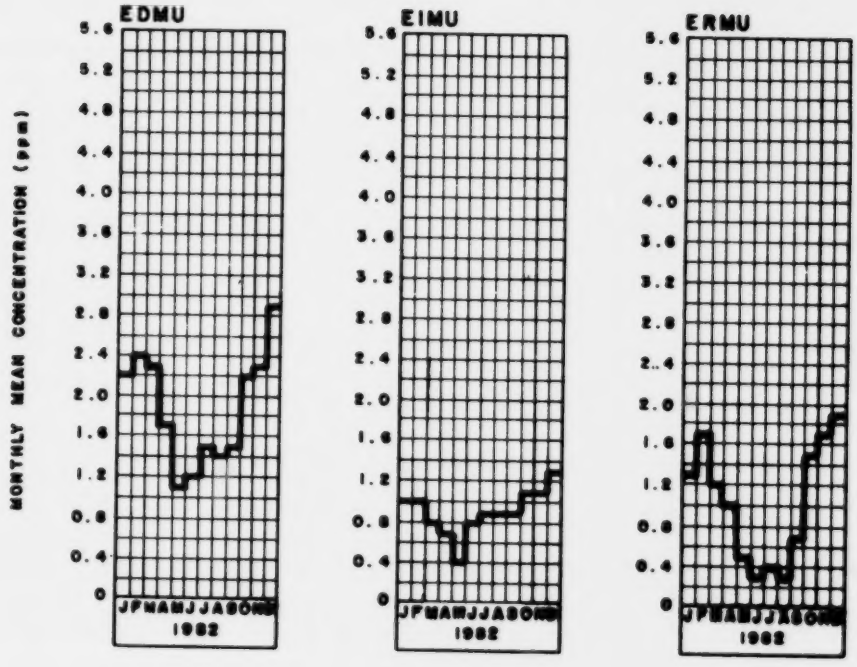
Alberta ENVIRONMENT
Pollution Control Division
Air Quality Control Branch

MAXIMUM LEVELS REGULATIONS
1-HOUR-13 PPM 8-HOUR-5 PPM

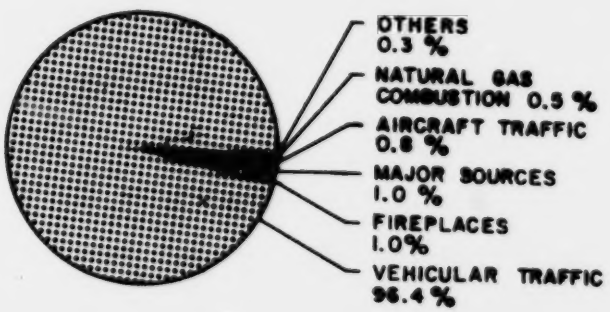
| MONTH | ARITHMETIC MEAN (ppm) | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | PERCENT COMPLIANCE WITH REGULATIONS | |
|---|---|---|---|---|
| | | | 1-HR | 8-HR |
| **EDMU** | | | | |
| January, 1982 | 2.2 | 97.4 | 100 | 93.4 |
| February | 2.4 | 96.0 | 99.4 | 90.1 |
| March | 2.3 | 97.6 | 100 | 97.8 |
| April | 1.7 | 97.5 | 100 | 100 |
| May | 1.1 | 97.3 | 100 | 100 |
| June | 1.2 | 95.0 | 100 | 100 |
| July | 1.5 | 97.3 | 100 | 100 |
| August | 1.4 | 97.2 | 100 | 100 |
| September | 1.5 | 96.7 | 100 | 100 |
| October | 2.2 | 97.3 | 99.9 | 97.8 |
| November | 2.3 | 97.5 | 100 | 94.3 |
| December | 2.9 | 97.3 | 98.8 | 85.6 |
| **EIMU** | | | | |
| January, 1982 | 1.0 | 96.9 | 100 | 98.9 |
| February | 1.0 | 96.1 | 100 | 100 |
| March | 0.8 | 90.9 | 100 | 100 |
| April | 0.7 | 95.8 | 100 | 100 |
| May | 0.4 | 97.2 | 100 | 100 |
| June | 0.8 | 97.9 | 100 | 100 |
| July | 0.9 | 90.5 | 100 | 100 |
| August | 0.9 | 96.0 | 100 | 100 |
| September | 0.9 | 95.7 | 100 | 100 |
| October | 1.1 | 93.7 | 100 | 100 |
| November | 1.1 | 96.3 | 100 | 100 |
| December | 1.3 | 95.8 | 100 | 97.8 |
| **ERMU** | | | | |
| January, 1982 | 1.3 | 91.0 | 99.7 | 98.8 |
| February | 1.7 | 97.0 | 99.4 | 95.1 |
| March | 1.2 | 97.2 | 100 | 97.8 |
| April | 1.0 | 97.2 | 99.9 | 98.9 |
| May | 0.5 | 97.7 | 100 | 100 |
| June | 0.3 | 97.1 | 100 | 100 |
| July | 0.4 | 97.2 | 100 | 100 |
| August | 0.3 | 97.6 | 100 | 100 |
| September | 0.7 | 97.4 | 100 | 100 |
| October | 1.5 | 96.8 | 99.4 | 95.6 |
| November | 1.7 | 96.3 | 99.7 | 93.1 |
| December | 1.9 | 96.2 | 99.7 | 93.3 |

# FIGURE 9 - CARBON MONOXIDE

## MONTHLY MEANS




## SOURCE AND EMISSION INVENTORY




RELATIVE CONTRIBUTION OF EACH CATEGORY TO TOTAL CARBON MONOXIDE EMISSIONS IN THE EDMONTON AREA, 1982

CARBON MONOXIDE
118,073 tonnes

Alberta
ENVIRONMENT
Pollution Control Division

F. SULPHUR DIOXIDE ($SO_2$)

Sulphur dioxide constitutes one of the major air pollutants on a global basis. It may oxidize and combine with moisture to form sulphuric acid and, as such, increase its harmful effects on vegetation and the respiratory systems of humans and animals. When combined with particulate matter, it exerts a synergistic effect that is more harmful than the effect of either pollutant.

Sulphur dioxide pollution results primarily from man-made sources such as combustion of fossil fuels, smelting and roasting of sulphur containing ores, kraft and sulphite wood pulping and sour gas processing. In Alberta during 1982, an estimated 244 thousand metric tons of sulphur were emitted into the atmosphere from man-made (primarily industrial operations) sources. About 46 percent of the sulphur emissions was contributed by sulphur extraction plants; oil sands plants and power plants contributed about 25 percent and 14 percent respectively. The remaining 15 percent came from sources such as gas plant flares, oil refineries, pulp and paper mills and fertilizer plants.[5]

A summary of the sulphur dioxide data collected during the 1982 report period is presented in Table 12. All sulphur dioxide readings were well below the Regulations, resulting in 100% compliance.

Figure 10 illustrates the $SO_2$ "Source and Emission Inventory" for the Edmonton area and includes a graph of total sulphation levels. Although the total sulphation cylinders are static monitors and yield only monthly average values, the data do provide valuable trend information and, therefore, are included in this section.

The lowest total sulphation levels of the period occurred in February and September (0.06 mg. $SO_3$ equiv./day/100 sq. cm.), with the highest level of 0.24 mg. $SO_3$ equiv./day/100 sq. cm. occurring in December (Figure 10). All monthly mean concentration levels were below the 0.5 mg. $SO_3$ equiv./day/100 sq. cm. guideline (Figure 10).

Alberta ENVIRONMENT
Pollution Control Division
Air Quality Control Branch

TABLE 12
SULPHUR DIOXIDE

MAXIMUM LEVELS REGULATIONS
1-HOUR-0.17 PPM 24-HOUR-0.06 PPM

EIMU

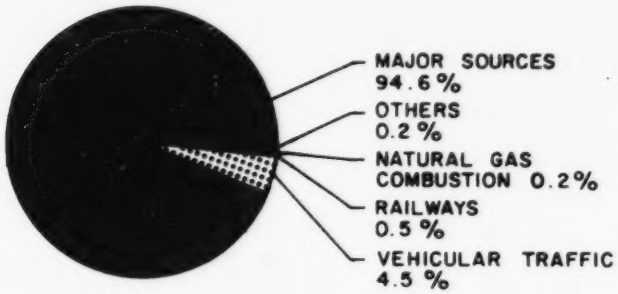
| MONTH | ARITHMETIC MEAN (ppm) | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | PERCENT COMPLIANCE WITH REGULATIONS | |
|---|---|---|---|---|
| | | | 1-HR | 24-HR |
| January, 1982 | 0.00 | 91.1 | 100 | 100 |
| February | 0.00 | 93.9 | 100 | 100 |
| March | 0.00 | 88.7 | 100 | 100 |
| April | 0.00 | 95.4 | 100 | 100 |
| May | 0.00 | 91.4 | 100 | 100 |
| June | 0.00 | 95.8 | 100 | 100 |
| July | 0.00 | 95.3 | 100 | 100 |
| August | 0.00 | 95.6 | 100 | 100 |
| September | 0.00 | 95.4 | 100 | 100 |
| October | 0.00 | 95.8 | 100 | 100 |
| November | 0.00 | 94.0 | 100 | 100 |
| December | 0.00 | 93.1 | 100 | 100 |

# FIGURE 10- SULPHUR DIOXIDE

## NOTE

THE MONTHLY MEAN CONCENTRATIONS WERE 0.00 ppm THROUGHOUT THE REPORT YEAR AT EIMU.

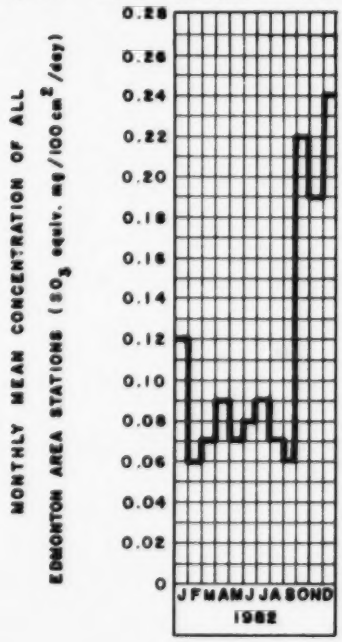
## SOURCE AND EMISSION INVENTORY




RELATIVE CONTRIBUTION OF EACH CATEGORY TO TOTAL SULPHUR DIOXIDE EMISSIONS IN THE EDMONTON AREA, 1982

SULPHUR DIOXIDE
9903 tonnes

## MONTHLY MEAN TOTAL SULPHATION LEVELS




Alberta
ENVIRONMENT
Pollution Control Division

G. TOTAL HYDROCARBONS (THC)

The hydrocarbons considered in this section are those which exist in the atmosphere in the gaseous phase. They are important because they are precursors of compounds formed in the atmospheric photochemical system. Therefore, any assessment of the effects of hydrocarbon pollution must be made in relation to the effects of photochemical air pollution.

The natural sources of the gas-phase hydrocarbons, of which methane is a major constituent, include trees and vegetation. For man-made sources, the "Source and Emission Inventory" (Figure 11) indicates that motor vehicles are the primary source (58.8%), with gasoline marketing being the second largest contributor (22.4%). Smaller contributions are made in areas such as major industrial sources (11.0%), dry cleaning (2.7%), fireplaces (1.8%), natural gas combustion (1.4%), urban fires (0.6%), aircraft traffic (0.5%), and other causes (0.8%). The motor vehicle emissions result from inefficient combustion. Inefficient combustion, which occurs before the vehicle reaches operating temperature, is particularly evident during the winter.

The levels of total hydrocarbons monitored during this report period (Table 13 and Figure 11) did not show any definitive trends on a seasonal basis. However, EIMU generally showed the highest readings of the three stations. EIMU is located in the vicinity of hydrocarbon storage and processing facilities, which explains why these higher average readings were monitored throughout the report year.

Currently there are no air quality Regulations for hydrocarbons.

TABLE 13
TOTAL HYDROCARBONS

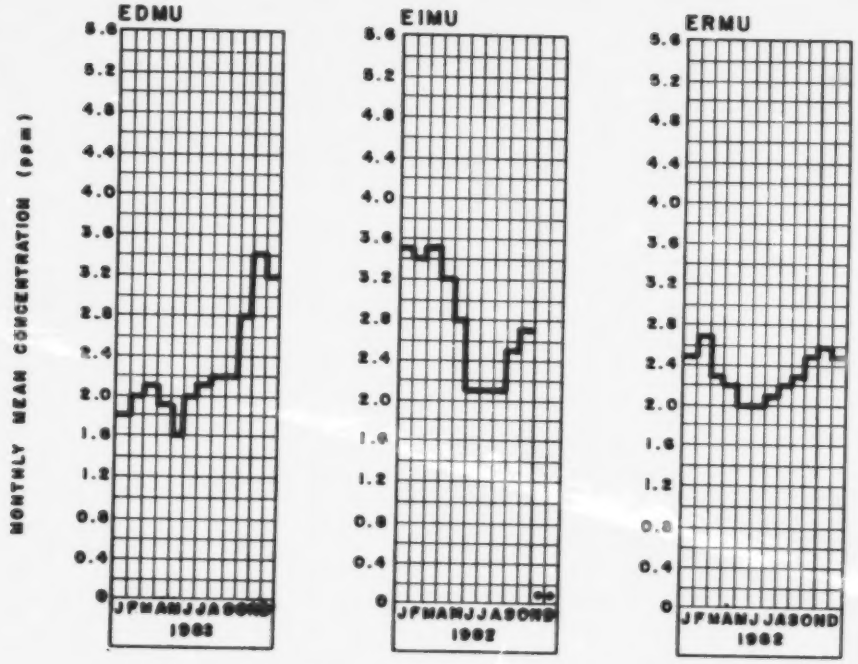
Alberta ENVIRONMENT Pollution Control Division Air Quality Control Branch

| MONTH | ARITHMETIC MEAN (ppm) | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | PERCENT COMPLIANCE WITH REGULATIONS | |
|---|---|---|---|---|
| | | | 1-HR | 24-HR |
| **EDMU** | | | | |
| January, 1982 | 1.8 | 88.0 | NO REGULATION | |
| February | 2.0 | 96.0 | | |
| March | 2.1 | 97.4 | | |
| April | 1.9 | 91.0 | | |
| May | 1.6 | 90.6 | | |
| June | 2.0 | 92.5 | | |
| July | 2.1 | 97.3 | | |
| August | 2.2 | 87.4 | | |
| September | 2.2 | 96.9 | | |
| October | 2.8 | 97.3 | | |
| November | 3.4 | 89.0 | | |
| December | 3.2 | 97.4 | | |
| **EIMU** | | | | |
| January, 1982 | 3.5 | 97.0 | NO REGULATION | |
| February | 3.4 | 97.2 | | |
| March | 3.5 | 87.5 | | |
| April | 3.2 | 88.8 | | |
| May | 2.8 | 96.4 | | |
| June | 2.1 | 88.5 | | |
| July | 2.1 | 97.2 | | |
| August | 2.1 | 96.5 | | |
| September | 2.5 | 96.5 | | |
| October | 2.7 | 96.8 | | |
| November | a | 46.9 | | |
| December | a | 33.7 | | |
| **ERMU** | | | | |
| January, 1982 | 2.5 | 93.1 | NO REGULATION | |
| February | 2.7 | 97.0 | | |
| March | 2.3 | 96.9 | | |
| April | 2.2 | 97.4 | | |
| May | 2.0 | 97.3 | | |
| June | 2.0 | 95.1 | | |
| July | 2.1 | 94.8 | | |
| August | 2.2 | 97.4 | | |
| September | 2.3 | 97.1 | | |
| October | 2.5 | 96.9 | | |
| November | 2.6 | 96.5 | | |
| December | 2.5 | 96.1 | | |

a Instrument operational less than 50%; insufficient data for calculation of mean.

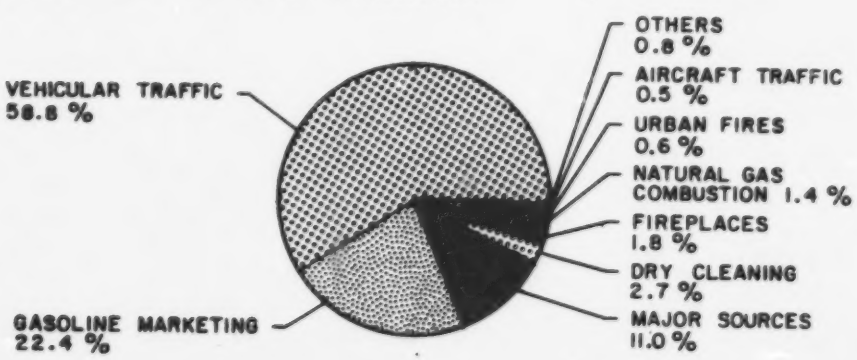
# FIGURE II - TOTAL HYDROCARBONS

## MONTHLY MEANS




• INSTRUMENT OPERATIONAL LESS THAN 80%; INSUFFICIENT DATA FOR CALCULATION OF MEAN.

## SOURCE AND EMISSION INVENTORY




RELATIVE CONTRIBUTION OF EACH CATEGORY TO TOTAL HYDROCARBON EMISSIONS IN THE EDMONTON AREA, 1982

HYDROCARBONS
16,504 tonnes

Alberta
ENVIRONMENT
Pollution Control Division

H. PARTICULATES

Particulate matter is composed of a wide variety of substances and encompasses any matter dispersed in the air where the individual particles are smaller in diameter than 500 microns (μ). It is the most commonly perceived form of pollution, often manifesting itself by interference with visibility, a soiling effect on materials or as a respiratory irritant. The characteristics of particles and particle dispersion are shown in Figure 12.

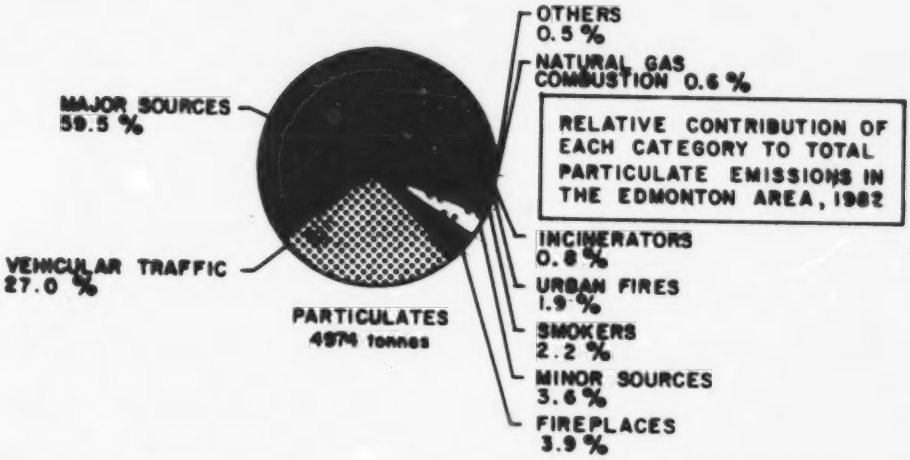
The "Source and Emission Inventory" (Figure 12) indicates that major industrial sources are the primary cause of particulate emissions, (59.5%), followed by vehicular traffic, (27.0%). Dust from sources such as wind erosion and construction activities is not included in this inventory, although it may in fact be the greatest overall source.

In the Edmonton metropolitan area, three types of sampling units are employed to measure particulate matter; therefore, the results for each type will be discussed separately in subsequent sections. The three types of samplers are the tape sampler, the high-volume sampler and the dustfall cylinder. The first two samplers measure suspended particulate matter while the latter measures total dustfall.

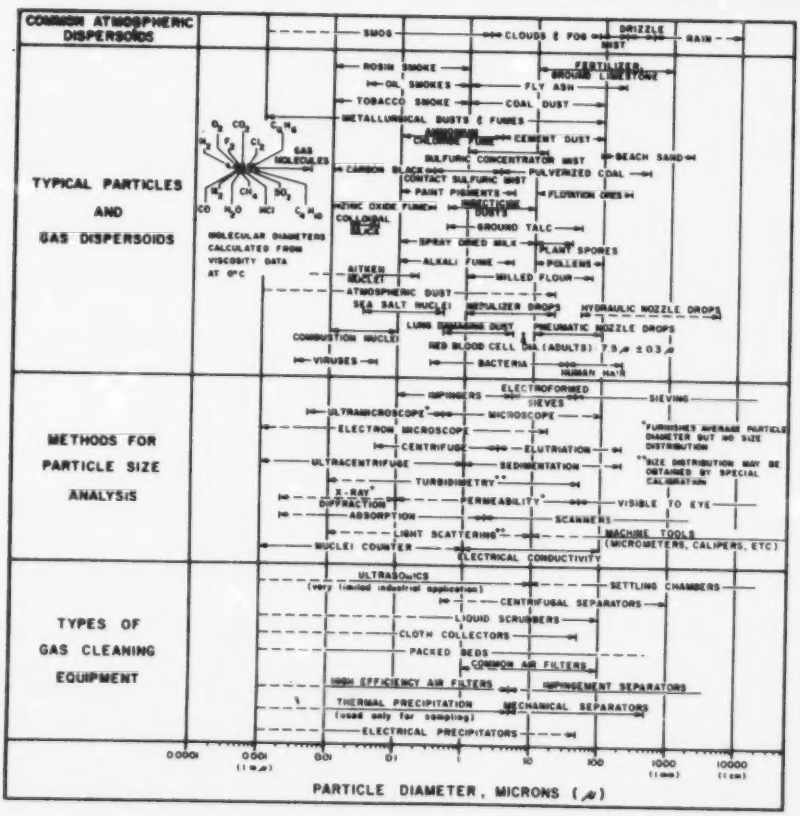
In general, particles smaller than 1 μ in diameter originate in the atmosphere, principally through condensation and combustion. Particles between 1 μ and 10 μ in diameter usually include soil, process dusts and combustion products from industries. Particles larger than 10 μ in diameter generally result from mechanical processes such as wind erosion, grinding, spraying and the pulverizing of materials by vehicles and pedestrians.[6]

# FIGURE 12 - TOTAL PARTICULATES

## SOURCE AND EMISSION INVENTORY




## CHARACTERISTICS OF PARTICLES AND PARTICLE DISPERSION




Aberta ENVIRONMENT
Pollution Control Division

H. 1. SOILING INDEX

Soiling index is the usual index of suspended particulate matter in the size range of 0.1 μ to 10 μ. It is not a measure of absolute concentrations as the method of analysis does not measure the deposited mass.

The types of suspended particulate matter identified as soiling index include smoke and fine dust particles. The samples are collected by drawing sample air through a filter paper over sampling cycles of one or two hours. The soiling properties of the sample are measured by the reduction of light transmission through the filter paper. This reduction is reported as a coefficient of haze (COH) per 1,000 linear feet of air sampled.

The guideline that "a minimum of 90% of readings per month shall be less than 1.0 COH" was complied with by all stations (Table 14). The lowest average levels for the report period were recorded during the spring at all three stations (Figure 13).

Alberta ENVIRONMENT Pollution Control Division Air Quality Control Branch

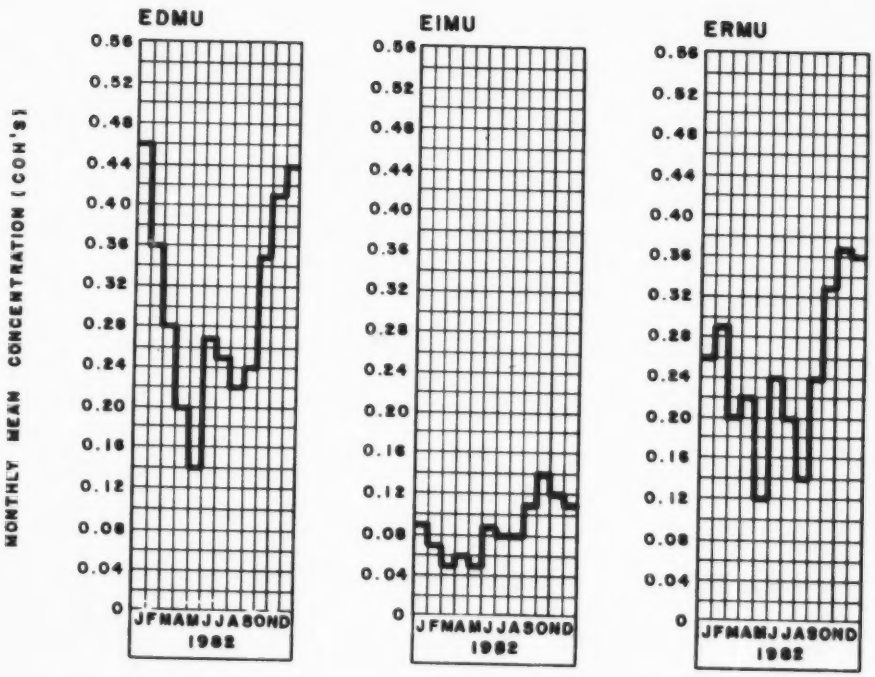
TABLE 14
SUSPENDED PARTICULATE MATTER/SOILING INDEX

GUIDELINE FOR SOILING INDEX
MINIMUM OF 90% OF READINGS PER MONTH
SHALL BE LESS THAN 1.0 COH

| MONTH | ARITHMETIC MEAN (COH) | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | PERCENT OF READINGS LESS THAN 1.0 COH |
|---|---|---|---|
| **EDMU** | | | |
| January, 1982 | 0.46 | 100 | 91.3 |
| February | 0.36 | 98.4 | 95.8 |
| March | 0.28 | 100 | 97.8 |
| April | 0.20 | 100 | 99.7 |
| May | 0.14 | 100 | 99.9 |
| June | 0.27 | 100 | 99.0 |
| July | 0.25 | 100 | 99.6 |
| August | 0.22 | 100 | 99.6 |
| September | 0.24 | 100 | 98.8 |
| October | 0.35 | 100 | 95.8 |
| November | 0.41 | 100 | 93.3 |
| December | 0.44 | 100 | 92.1 |
| **EIMU** | | | |
| January, 1982 | 0.09 | 100 | 99.9 |
| February | 0.07 | 99.6 | 100 |
| March | 0.05 | 97.7 | 100 |
| April | 0.06 | 99.9 | 100 |
| May | 0.05 | 97.6 | 100 |
| June | 0.09 | 100 | 100 |
| July | 0.08 | 99.9 | 100 |
| August | 0.08 | 100 | 99.9 |
| September | 0.11 | 100 | 99.7 |
| October | 0.14 | 100 | 99.7 |
| November | 0.12 | 100 | 100 |
| December | 0.11 | 99.3 | 99.7 |
| **ERMU** | | | |
| January, 1982 | 0.26 | 99.6 | 98.4 |
| February | 0.29 | 100 | 94.8 |
| March | 0.20 | 100 | 99.5 |
| April | 0.22 | 99.9 | 97.8 |
| May | 0.12 | 99.6 | 99.9 |
| June | 0.24 | 100 | 99.2 |
| July | 0.20 | 99.7 | 99.2 |
| August | 0.14 | 100 | 99.6 |
| September | 0.24 | 100 | 97.5 |
| October | 0.33 | 100 | 94.4 |
| November | 0.37 | 95.7 | 92.5 |
| December | 0.36 | 95.4 | 93.9 |

# FIGURE 13 – SUSPENDED PARTICULATES: SOILING INDEX

MONTHLY MEANS



H. 2. HIGH-VOLUME SAMPLER

Suspended particulate matter is also measured by the high-volume sampler. The sampler consists of a vacuum system and filter housed in a shelter. Suspended particulate matter in the atmosphere is determined by collecting 24-hour samples on the pre-weighed filter. The filter is then reweighed to determine the mass of the particles collected. This method gives a more accurate measurement of suspended particulate matter than the soiling index monitor.

The size of particles collected by the high-volume sampler range from 0.1 μ to 10 μ.

The levels of suspended particulate matter measured by the high-volume sampler (Table 15 and Figure 14) were occasionally in excess of the Clean Air (Maximum Levels) Regulation of 100 $\mu g/m^3$/24-hour at all three stations. No consistent seasonal pattern was apparent; however, average levels were generally lowest during the winter.

There was an average of 77.5% compliance achieved with the Regulation for suspended particulate matter, averaged for all three monitoring stations over the report year. Blowing dust from roads, surrounding fields, construction sites, gardens, etc. are sources which could have contributed to the periods of non-compliance.

TABLE 15
SUSPENDED PARTICULATE MATTER/HIGH-VOLUME SAMPLER

MAXIMUM LEVELS REGULATIONS
24-HOUR-100 $\mu g/m^3$

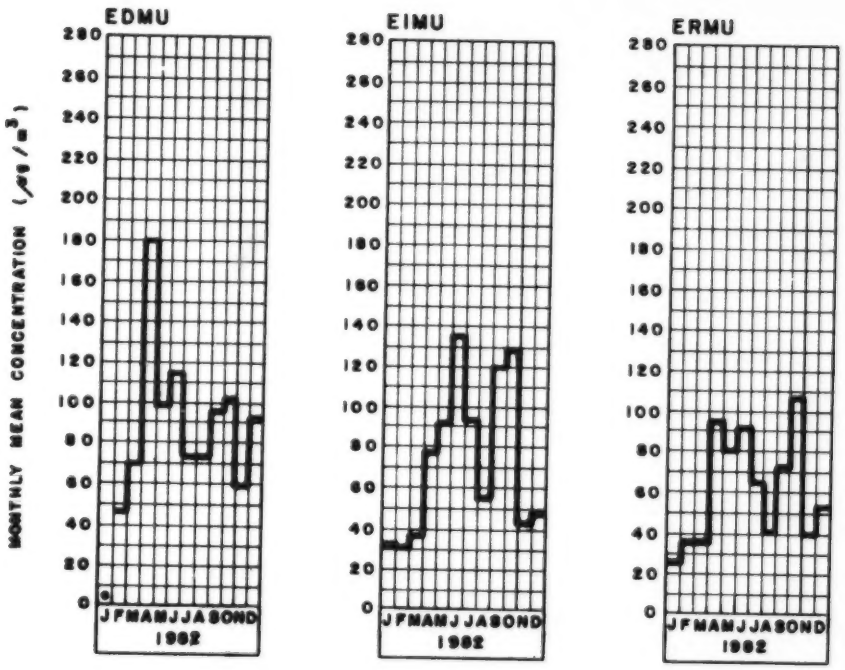
| MONTH | ARITHMETIC MEAN ($\mu g/m^3$) | PERCENTAGE OF TIME INSTRUMENT OPERATIONAL | PERCENT COMPLIANCE WITH REGULATION |
|---|---|---|---|
| **EDMU** | | | |
| January, 1982 | a | 20 | - |
| February | 47 | 100 | 100 |
| March | 70 | 100 | 80 |
| April | 180 | 100 | 40 |
| May | 99 | 100 | 60 |
| June | 115 | 100 | 40 |
| July | 74 | 100 | 80 |
| August | 74 | 100 | 80 |
| September | 97 | 100 | 40 |
| October | 102 | 100 | 60 |
| November | 59 | 80 | 100 |
| December | 92 | 100 | 60 |
| **EIMU** | | | |
| January, 1982 | 33 | 80 | 100 |
| February | 31 | 100 | 100 |
| March | 38 | 100 | 100 |
| April | 78 | 100 | 80 |
| May | 91 | 80 | 25 |
| June | 136 | 100 | 20 |
| July | 94 | 80 | 75 |
| August | 56 | 100 | 100 |
| September | 120 | 100 | 60 |
| October | 129 | 100 | 60 |
| November | 43 | 100 | 100 |
| December | 48 | 100 | 100 |
| **ERMU** | | | |
| January, 1982 | 26 | 100 | 100 |
| February | 36 | 100 | 100 |
| March | 36 | 100 | 100 |
| April | 95 | 100 | 60 |
| May | 80 | 100 | 80 |
| June | 91 | 100 | 60 |
| July | 65[b] | 60 | 67 |
| August | 41 | 100 | 100 |
| September | 72 | 100 | 100 |
| October | 108 | 100 | 80 |
| November | 40 | 100 | 100 |
| December | 54 | 100 | 100 |

a Instrument operational less than 50%; insufficient data for calculation of mean.

b Instrument operational less than 75%; monthly mean may not be representative.

# FIGURE 14 - SUSPENDED PARTICULATE MATTER: HIGH - VOLUME SAMPLER

MONTHLY MEANS




• INSTRUMENT OPERATIONAL LESS THAN 50%; INSUFFICIENT DATA FOR CALCULATION OF MEAN.

H.3. TOTAL DUSTFALL

Total dustfall includes particles in the size range greater than 10 μ. Since these particles have appreciable settling capabilities, they are collected by deposition in a dustfall jar or cylinder. The dustfall cylinders are generally exposed for 30-day periods and yield integrated dustfall values for that period.

The large particles collected by dustfall cylinders settle readily at low velocities. Therefore, total dustfall cylinders provide a measure of dust arising from local sources. Quite often high dustfall levels are attributable to nearby construction or vehicular traffic on a dusty road.

The results of the monitoring of total dustfall during the 1982 report period are presented in Table 16 and Figure 15. The readings are actual measured levels and are not corrected for "normal background levels." The data indicate that the lowest levels were monitored during the winter months.

When the total dustfall levels are compared with the Clean Air (Maximum Levels) Regulations, which distinguish between residential-recreational (53 mg/100 $cm^2$/30 days) and commercial-industrial (158 mg/100 $cm^2$/30 days) areas, a high frequency of readings in excess of the Regulations is noted in the residential-recreational areas.

There were averages of 71.8% compliance and 81.1% compliance respectively with the residential/recreational area and the commercial/industrial area total dustfall Regulations. Blowing dust from roads, surrounding fields, construction sites, gardens, etc. are sources which could have contributed to the periods of non-compliance.

TABLE 16
TOTAL DUSTFALL

MAXIMUM LEVELS REGULATIONS
53 mg/100 $cm^2$/30 days in residential and recreational areas.
158 mg/100 $cm^2$/30 days in commercial and industrial areas.

RESIDENTIAL AND RECREATIONAL AREA STATIONS

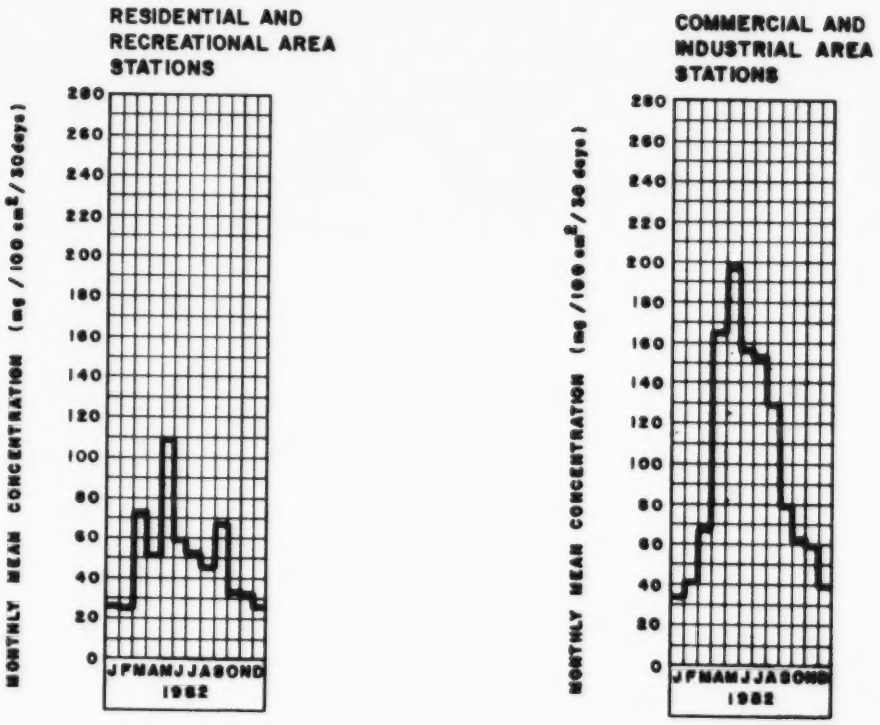
| MONTH | ARITHMETIC MEAN (mg/100 $cm^2$ /30 days) | PERCENTAGE OF STATIONS REPORTING DATA | PERCENTAGE OF STATIONS IN COMPLIANCE WITH REGULATION |
|---|---|---|---|
| January, 1982 | 27 | 100 | 100 |
| February | 26 | 100 | 100 |
| March | 73 | 93 | 86 |
| April | 51 | 100 | 53 |
| May | 109 | 87 | 8 |
| June | 59 | 100 | 33 |
| July | 52 | 80 | 42 |
| August | 46 | 100 | 60 |
| September | 68 | 100 | 67 |
| October | 33 | 100 | 100 |
| November | 32 | 100 | 100 |
| December | 27 | 100 | 100 |

COMMERCIAL AND INDUSTRIAL AREA STATIONS

| | | | |
|---|---|---|---|
| January, 1982 | 34 | 100 | 100 |
| February | 41 | 100 | 100 |
| March | 68 | 100 | 100 |
| April | 165 | 100 | 67 |
| May | 198 | 89 | 50 |
| June | 157 | 100 | 67 |
| July | 153 | 100 | 67 |
| August | 129 | 100 | 67 |
| September | 79 | 89 | 87 |
| October | 62 | 100 | 100 |
| November | 59 | 100 | 100 |
| December | 39 | 100 | 100 |

# FIGURE 15 - TOTAL DUSTFALL

## MONTHLY MEANS



## V. METEOROLOGICAL DATA

Air pollution levels depend upon atmospheric stability and wind. Stable air near the ground is modified by the input of heat from the city and heat from the sun. Pollutants tend to become uniformly distributed in this modified region which is called the "mixing layer". The height of the mixing layer and the mean wind speed determine the "ventilation", which may be viewed as the effectiveness of pollutant dispersal with respect to urban area sources. Poor ventilation, known also as "stagnation", leads to an increase in pollutant concentrations. Good ventilation will keep the concentrations low.

During the night, the surface of the earth loses heat to space and cools the air immediately above it, forming the nocturnal radiation inversion layer in which the temperature increases with height. The height of this inversion and its intensity control the development of the mixing layer.

To measure these important parameters, wind and temperature soundings were made at a rural station to the south of the city. The data for 1982 are summarized in Table 17.

As compared with 1981, the spring of 1982 had deeper and stronger early morning inversions. The fall of 1982 was similar to the fall of 1981 in both frequency and depth of early morning inversions, but as with the spring, they were stronger than in 1981. As compared with 1981, midday mixing heights in 1982 were slightly lower in the spring and substantially lower in the fall. Afternoon mixing heights in the spring and fall of 1982 were similar to those of 1981. In summary, it appears that the meteorological air pollution potential in 1982 was somewhat higher than it was in 1981.

TABLE 17

SUMMARY OF LOWER ATMOSPHERE SOUNDINGS
ALBERTA ENVIRONMENT
ELLERSLIE STATION

| Frequencies/Median values | Jan '82 | Apr '82 | Jul '82 | Oct '82 |
|---|---|---|---|---|
| 06:00 MST | | | | |
| Days with ground-based inversions | - | - | 7 | - |
| Ground-based inversion height (m) | - | - | 414 | - |
| Potential temperature gradient (°C/100m) | - | - | 2.0 | - |
| Days with mixing layer | - | - | 8 | - |
| Mixing layer heignt (m) | - | - | 72 | - |
| Wind speed in lowest hundred meters (m/s) | - | - | 4.0 | - |
| 07:30 MST | | | | |
| Days with ground-based inversions | - | 13 | 2 | 15 |
| Ground-based inversion height (m) | - | 315 | 90 | 315 |
| Potential temperature gradient (°C/100m) | - | 2.3 | 1.0 | 3.3 |
| Days with mixing layer | - | 4 | 14 | 3 |
| Mixing layer height (m) | - | 245 | 282 | 180 |
| Wind speed in lowest hundred meters (m/s) | - | 5.2 | 3.6 | 6.5 |
| 09:00 MST | | | | |
| Days with ground-based inversions | 10 | 6 | - | 9 |
| Ground-based inversion height (m) | 488 | 315 | - | 414 |
| Potential temperature gradient (°C/100 m) | 3.2 | 1.8 | - | 2.5 |
| Days with mixing layer | 7 | 11 | 16 | 10 |
| Mixing layer height (m) | 381 | 216 | 480 | 126 |
| Wind speed in lowest hundred meters (m/s) | 3.9 | 4.5 | 3.1 | 5.6 |
| 10:30 MST | | | | |
| Days with ground-based inversions | 5 | - | - | - |
| Ground-based inversion height (m) | 348 | - | - | - |
| Potential temperature gradient (°C/100m) | 2.5 | - | - | - |
| Days with mixing layer | 12 | - | - | - |
| Mixing layer height (m) | 315 | - | - | - |
| Wind speed in lowest hundred meters (m/s) | 3.6 | - | - | - |
| 12:00 MST | | | | |
| Days with ground-based inversions | 4 | 4 | - | 3 |
| Ground-based inversion height (m) | 290 | 63 | - | 612 |
| Potential temperature gradient (°C/100m) | 2.0 | 2.0 | - | 1.9 |
| Days with mixing layer | 13 | 13 | 17 | 16 |
| Mixing layer height (m) | 180 | 579 | 958 | 282 |
| Wind speed in lowest hundred meters (m/s) | 3.4 | 4.0 | 3.1 | 5.7 |
| 15:00 MST | | | | |
| Days with ground-based inversions | 4 | 3 | - | - |
| Ground-based inversion height (m) | 332 | 108 | - | - |
| Potential temperature gradient (°C/100m) | 1.8 | 1.1 | - | - |
| Days with mixing layer | 11 | 11 | - | 15 |
| Mixing layer height (m) | 381 | 769 | - | 675 |
| Wind speed in lowest hundred meters (m/s) | 4.4 | 4.2 | - | 4.9 |

## VI. INDEX OF THE QUALITY OF THE AIR (IQUA)

The IQUA is an indicator of the status of existing air quality. It is based on the 1-hour and 24-hour concentrations of nitrogen dioxide, sulphur dioxide, and soiling index (COH), on the 1-hour and 8-hour concentrations of carbon monoxide, and on the 1-hour concentrations of ozone. An index is calculated for each of the five pollutants. The maximum index is then used as the numerical value of IQUA. An IQUA reading of 0-25 indicates good air quality, 26-50 is fair, 51-100 is poor and greater than 100 is very poor.

In Edmonton, the IQUA is calculated at three locations: EDMU, ERMU and EIMU, with the index made available to the media and public routinely. It is generally issued at 0800 and 1500 hours on weekdays, except when the index values are greater than 50. In the latter case, it is generally issued every hour until the index value falls below 50.

A summary of the air quality indices for the three monitoring stations is presented in Table 18. During the report year, the air quality was generally good (0-25 as an arithmetic mean). On occasion, however, index values in the poor and very poor categories were observed. Such values were usually a result of high soiling index levels.

Alberta
ENVIRONMENT
Pollution Control Division
Air Quality Control Branch

TABLE 18

INDEX OF THE QUALITY OF THE AIR (IQUA)

| | EDMU | EIMU | ERMU |
|---|---|---|---|
| MONTH | ARITHMETIC MEAN | ARITHMETIC MEAN | ARITHMETIC MEAN |
| January, 1982 | 29 | 15 | 17 |
| February | 30 | 16 | 22 |
| March | 21 | 18 | 21 |
| April | 19 | 20 | 23 |
| May | 16 | 20 | 19 |
| June | 19 | 19 | 19 |
| July | 17 | 17 | 17 |
| August | 13 | 11 | 13 |
| September | 14 | 10 | 14 |
| October | 20 | 11 | 19 |
| November | 22 | 11 | 20 |
| December | 25 | 12 | 20 |

## VII. SUMMARY AND CONCLUSIONS

From the foregoing analysis of the data, the following can be concluded:

1. During the report year the air quality index in the Edmonton area was generally in the "good" range (0-25 as an arithmetic mean).
2. All nitrogen dioxide readings were 100% in compliance with the Regulations, with the exception of 99.7% compliance and 96.0% compliance in February with the 1-hour and 24-hour Regulations respectively at EDMU. Vehicular traffic exhaust is responsible for the small amount of non-compliance time.
3. High natural background ozone levels in Alberta resulted in a significant number of readings in excess of the 24-hour ozone Regulation. There was an average of 67.9% compliance with the 24-hour ozone Regulation for all three monitoring stations for the report year. Good compliance was achieved with the 1-hour ozone Regulation (average of 99.9% compliance for all three monitoring stations for the report year).
4. There were averages of 99.9% compliance and 99.3% compliance respectively with the 1-hour and the 8-hour carbon monoxide Regulations, averaged for all three monitoring stations for the report year. Vehicular traffic exhaust is responsible for the small amount of non-compliance time.
5. All sulphur dioxide readings were well below the Regulations, resulting in 100% compliance.

6. All soiling index (coefficient of haze-COH) readings were 100% in compliance with the Alberta guideline.
7. There was an average of 77.5% compliance achieved with the Regulation for suspended particulate matter (0.1 μ to 10 μ size range), averaged for all three monitoring stations over the report year. Blowing dust from roads, surrounding fields, construction sites, gardens, etc. are sources which could have contributed to the periods of non-compliance.
8. There were averages of 71.8% compliance and 81.1% compliance respectively with the residential/recreational area and the commercial/industrial area total dustfall (greater than 10 μ size) Regulations. Blowing dust from roads, surrounding fields, construction sites, gardens, etc. are sources which could have contributed to the periods of non-compliance.
9. Considering data from 1974 to 1982,
   a) no apparent significant trends were found for carbon monoxide at any of the three monitoring stations, nor did soiling index (coefficient of haze) exhibit any significant trend at EIMU.
   b) upward trends were found for soiling index at both ERMU and EDMU, for ozone at EIMU and for nitrogen dioxide at ERMU and EIMU.
   c) downward trends were found for ozone at EDMU and ERMU and for nitrogen dioxide at EDMU.

## VIII. REFERENCES

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